LAND CONSERVATION AND COMPACT GROWTH: THE KEYS TO WATER AVAILABILITY, WATER TREATMENT AND FLOOD CONTROL

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Conserving California's Heartland

Southern Sierra Partnership

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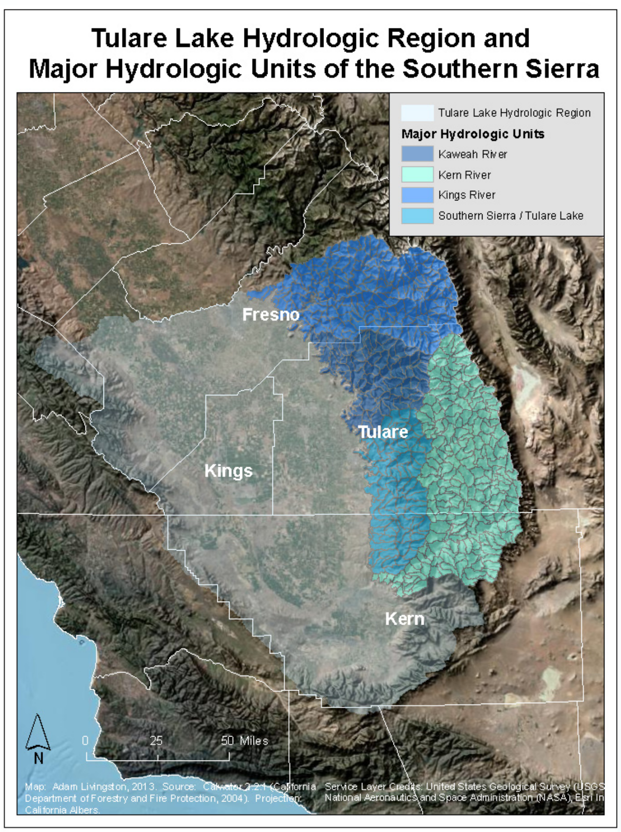
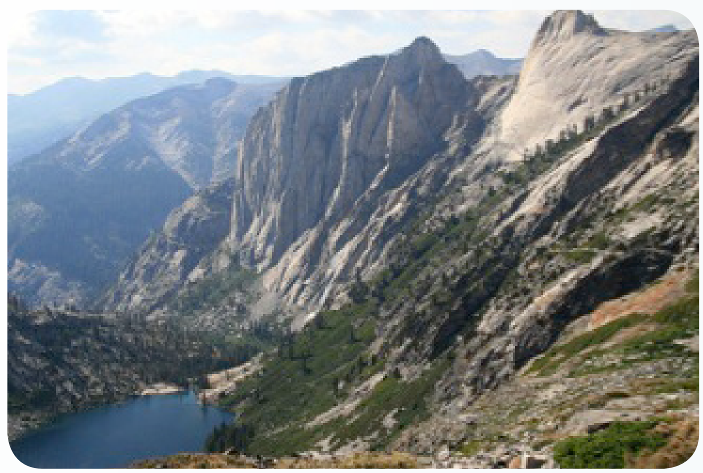
A. WATER AVAILABILITY

While the land base is the foundation of the region's economy, its productivity depends on water. Nearly three fourths of the water that enters the Tulare Lake Hydrologic Region—a closed basin that encompasses all but the northern edge of Fresno County and the southeastern portion of Kern—comes from precipitation, with the remainder being imported through the California Aqueduct, the Friant-Kern Canal and other water delivery infrastructure.[1]



Tulare Lake Hydrologic Region and major hydrologic units in the Southern Sierra (California Department of Forestry and Fire Protection, 2004). The hydrologic units depicted here bring water from the Sierra snowpack to rivers, including the Kings, Kaweah and Kern, and to the area that was once filled by Tulare Lake.

But, due in part to evaporation, runoff and other outflows, the 10 to 15 million acre-feet of water that the region's farms and cities consume each year are largely derived from imported water and groundwater.[2] In the Eastern San Joaquin Valley, local surface water, including water flowing from the Sierras, provides 52.6% of the water supply, groundwater provides 32.6%, and 14.8% is imported.[3] But in the Western San Joaquin Valley, more than 85% of the water supply is imported by the State Water Project and the Central Valley Project, and two thirds of the remainder comes from groundwater.[4]



Headwaters of the Middle Fork of the Kaweah River in Sequoia National Park. Photo: "Dcrjsr," 2006.

1. The danger of relying on imported water and groundwater

Because of its reliance on imported water and groundwater pumping, the region is vulnerable to fluctuations in the water supply. This was dramatically illustrated in 2009, when a combination of drought and pumping restrictions reduced the amount of water available in the western portions of Fresno, Kings and Kern Counties.[5] From 2008 to 2009, the combined number of harvested acres in these counties fell by nearly 231,000.[6] An estimated $343 million - $368 million in agricultural revenue was lost,[7] as were more than 5,500 jobs.[8] This may not be a unique event, as erratic weather patterns and ongoing climate change suggest that water supplies could become less reliable over time.[9]

Moreover, the region is rapidly depleting its once-abundant groundwater supplies. A 2008 U.S. Geological Survey report found that withdrawal of groundwater for agricultural use has "greatly exceeded natural recharge and resulted in large water-level declines," a problem exacerbated by the use of groundwater to meet urban water demand.[10] From 1962 to 2003, groundwater in the Central Valley was lost at an average rate of approximately 1,900 cubic feet per second.[11] Overpumping continued in the past decade: from October 2003 to March 2010, groundwater levels in the Central Valley declined by approximately 20.4 mm (0.8 inches) per year.[12] The total volume of groundwater lost was 20.3 cubic kilometers.[13] This translates to 16.5 million acre-feet or 20.3 trillion gallons—over three times the total water volume of the San Francisco Bay at mean tide.[14]

Remaining groundwater supplies are increasingly contaminated. A 2005 study found that fresh water in deep aquifers is giving way to water with high salt concentrations, making these supplies "less suitable for drinking or irrigation water purposes."[15] Closer to the surface, nitrates and two commonly-used pesticides are becoming increasingly common in the groundwater of the Eastern San Joaquin Valley.[16] Based on these findings, and the region's history of agricultural chemical use, it is expected that nitrate and pesticide concentrations in deeper areas—and therefore in public supply wells—will increase over time.[17]

2. *Securing water from the Sierras through land conservation*

If the region cannot rely on imported water, and will eventually run out of usable groundwater, its farms, cities and reservoirs will depend on water from precipitation and runoff. Much of this water falls as snow in the Sierras: the average annual water yield can be between 7 and 13 acre-feet in the mountains, but rarely exceeds 3 acre-feet on the Valley floor.[18] Melted snowpack and other runoff from the mountains is collected by watersheds, including those that feed the Kings, Kaweah and Kern Rivers, and brought to the Valley floor.[19] By protecting the lands that make up these watersheds—including rangeland in the Sierra foothills and important groundwater recharge areas in lower-elevation river deltas—the region can maximize the amount of water it receives from the Sierras.[20] If managed to avoid overuse, this water could also help the region to replenish its rapidly-declining groundwater supplies.[21]

3. *Limiting water consumption through compact growth*

Similarly, by meeting the demand for multifamily housing[22] and channeling development into existing urban centers, the region can save water that might otherwise be used for lawns and golf courses. A statewide development pattern based on conservation and compact growth (the "Green Future" scenario modeled in the Vision California process) would allow the average household to use 55,000 fewer gallons of water per year by 2050, saving a cumulative total of nearly 78 million acre-feet of water.[23] In the San Joaquin Valley, a development pattern based on the Valleywide

Photo: Sequoia Riverlands Trust, 2009.

Hybrid scenario would allow the average household to save more than 18,000 gallons per year, which would translate to annual Valley-wide savings of 680,000 acre-feet of water per year.[24] This is more than half of the amount devoted to urban water systems annually in the Tule Lake Hydrologic Region from 1998 through 2005.[25]

B. WATER TREATMENT

Land conservation and compact growth can also help the region to save on water treatment costs. Natural systems such as wetlands can play a significant role in removing pollutants from the region's water supply, performing tasks that would otherwise require additional water treatment infrastructure.[26] For example, Central Valley wetlands in the USDA Wetland Reserve Program may be able to remove most nitrate-nitrogen (NO_3-N) from otherwise unpolluted water within 18 days.[27] Indeed, the role that wetlands can play in bioremediation has been known for decades. In 1974, the community of Arcata saved $25 million by using the Arcata Marsh and Wildlife Sanctuary—a coastal marsh that was previously a brownfield—to treat wastewater naturally instead of building a new sewage plant.[28]

Forests in Southern Sierra watersheds can also contribute to water quality. Trees regulate runoff and supply, control erosion (thereby reducing sediment loads), and filter pathogens, pesticides, metals and other contaminants.[29] Because this work would otherwise need to be done by human-built filtration systems, water treatment services provided by trees are a significant asset to the region's economy. According to a 1998 study, for example, estimated annual values of water-related services provided by forests globally include $35.20 per acre of forest for waste treatment, and $38.80 per acre for erosion control and sediment retention ($49.73 and $54.82, respectively, in 2013 dollars).[30]

Moreover, compact development patterns can provide additional savings by reducing per capita amounts of major pollutants in stormwater. A 2009 study found that denser development patterns are correlated with decreased per capita nitrogen, phosphorous and suspended solid loads.[31] Indeed, the authors concluded that "a simple doubling of standard suburban densities . . . in most cases could do more to reduce contaminant loadings . . . than many traditional stormwater [management practices]."[32]

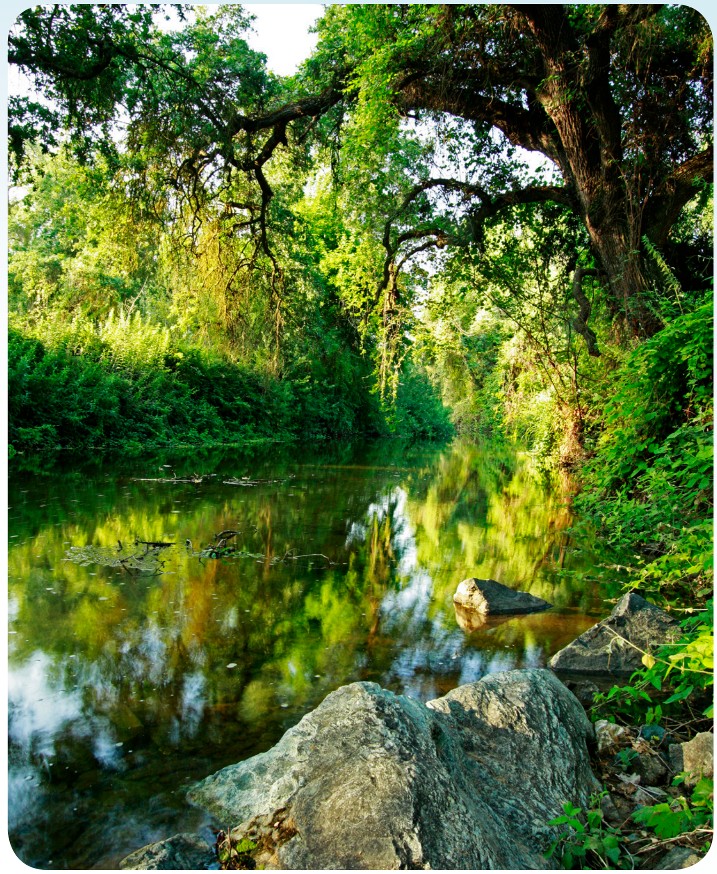
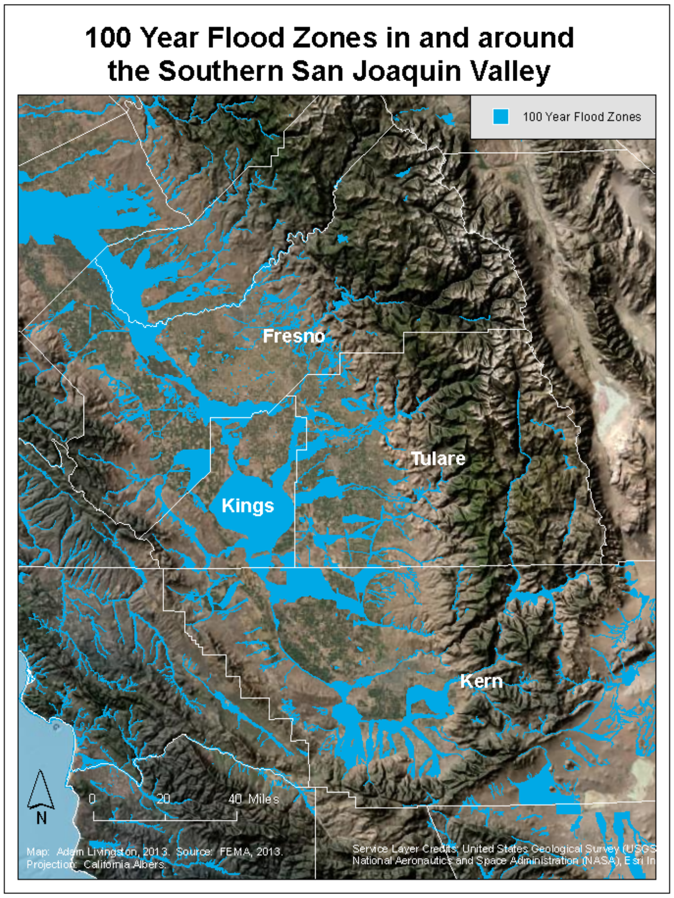


Photo: John Greening, 2009.

C. FLOOD CONTROL

The San Joaquin Valley has long been prone to flooding: the Tulare Lake Basin alone is estimated to have had over 180 floods in the past two millennia, including one in 2010 that caused up to $66.5 million in damage to crops and infrastructure.[33] Much of the region is within the 100 year flood zone (see map below), and the 200 year and 500 year flood zones extend even further.[34] Parts of the San Joaquin Valley are protected by levees (and therefore deemed to be outside the 100 year flood zone), but even these areas are at risk, because they are vulnerable to floods that exceed the levees' design specifications.[35]

By conserving wetlands and avoiding development in the areas most prone to flooding, however, the region can limit both infrastructure costs and flood damage.



100 year flood zones in and around the Southern San Joaquin Valley (FEMA, 2013).

Wetlands can store significant quantities of water: in the Central Valley as a whole, areas in the USDA Wetland Reserve Program may be able to hold up to 3.9 billion cubic meters of floodwater.[36] This is equivalent to nearly eight times the volume of floodwater in New Orleans during the worst day of the Katrina disaster.[37]

The region can further limit flood risk by directing development away from 100 year and 200 year flood zones. Since many of these areas consist of farmland in Kings County, as well as neighboring areas of Fresno and Kern,[38] reducing flood risk will also benefit the economy by conserving productive agricultural land.

[1]DWR, 2009.
[2]DWR, 2009; Michael et al., 2010.
[3]Michael et al., 2010.
[4]Michael et al., 2010.
[5]Michael et al., 2010.
[6]Michael et al., 2010.
[7]Michael et al., 2010.
[8]Michael et al., 2010. Estimated job losses range from 5,567 (based on crop reports) to 7,434 (based on SWAP model results). Michael et al., 2010.
[9]From 2006-2011, for example, the region experienced extreme variation in precipitation, reservoir storage, snowpack and runoff. In the Tulare Lake Hydrologic Region, precipitation ranged from 60% of average (2007) to 150% of average (2011), reservoir storage ranged from 145% of average (2006) to 80% of average (2008), runoff ranged from 50% of average (2007) to 185% of average (2011), and snowpack ranged from 20% of average (2007) to 180% of average (2011). Great Valley Center and Sierra Nevada Research Institute, 2012.
[10]Reilly et al., 2008.
[11]Reilly et al., 2008.
[12]Famiglietti et al., 2011.
[13]Famiglietti et al., 2011.
[14]Famiglietti et al., 2011. The total volume of the San Francisco Bay at mean tide has been estimated to be more than 5 million acre feet. San Francisco Estuary Project, 1999.
[15]Schoups et al., 2005.
[16]Burow et al., 2008.
[17]Burow et al., 2008.
[18]SSP, 2010.
[19]DWR, 2009.
[20]A 1998 study estimated the productive use value of water flowing from forests in the Sierra Nevada to be $1.32 billion per year ($1.86 billion in 2013 dollars). Krieger, 2001; U.S. Bureau of Labor Statistics, 2013. But given the region's unsustainable reliance on groundwater, and the absolute necessity of water for both agriculture and urban areas, this is almost certainly an underestimate.
[21]SSP, 2010.
[22]Nelson, 2013.
[23]Calthorpe Associates, 2011.
[24]Calthorpe Associates, 2010.
[25]DWR, 2009.
[26]Newbold, 2005; Newbold, 2002.
[27]Duffy and Kahara, 2011.
[28]Gies, 2009.
[29]Nowak, 2007; Krieger, 2001.
[30]Krieger, 2001; U.S. Bureau of Labor Statistics, 2013.
[31]Jacob and Lopez, 2009.
[32]Jacob and Lopez, 2009.
[33]Austin, 2012; Ritchie, 2010.
[34]DWR, 2013.
[35]Ludy and Kondolf, 2012. Homebuyers outside the 100-year floodplain are often not informed of this risk, suggesting that the damage caused by a significant flood could be compounded by a lack of public preparedness. Ludy and Kondolf, 2012.
[36]Duffy and Kahara, 2011.
[37]According to Smith and Rowland (2006), the volume of floodwater in New Orleans reached approximately 131 billion gallons (486 million cubic meters) on September 2, 2005.
[38]DWR, 2013.